Informational Item on Locomotives and Marine Vessels

Emissions, Fuels, and Strategies for Emission Reductions

Air Resources Board Hearing
October 23, 2003

California Environmental Protection Agency

Air Resources Board

Overview

- Marine and Locomotive Emissions
- Strategies to Reduce Emissions
  - Marine
  - Locomotive
- Fuels - Opportunities for Reductions


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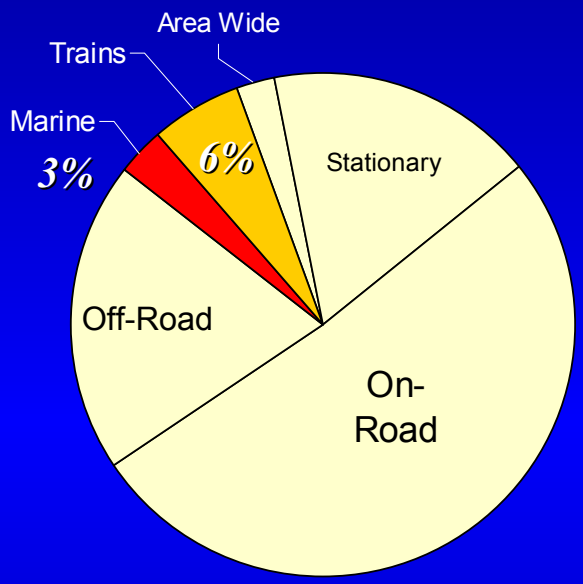
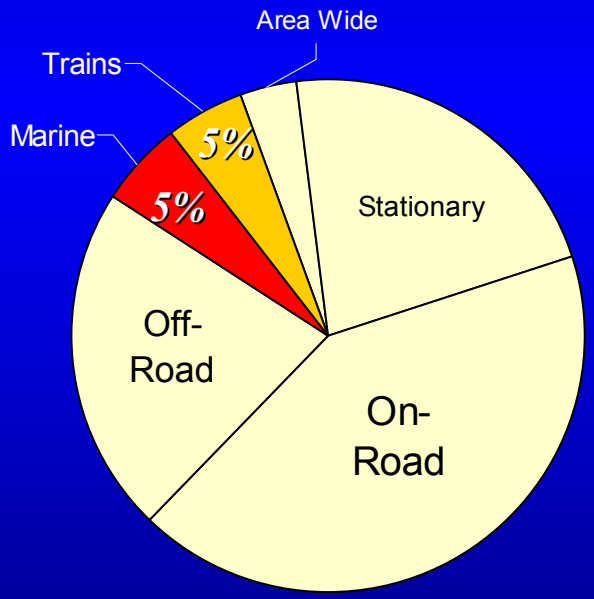
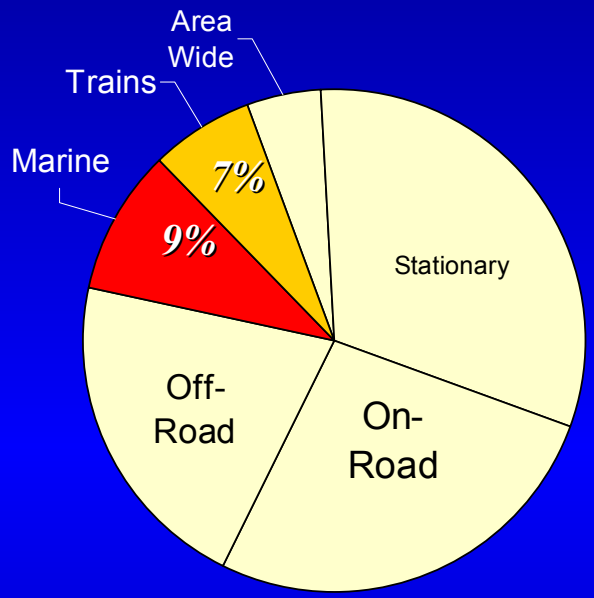
Marine & Locomotive Contribution to Statewide NOx Emissions



2000

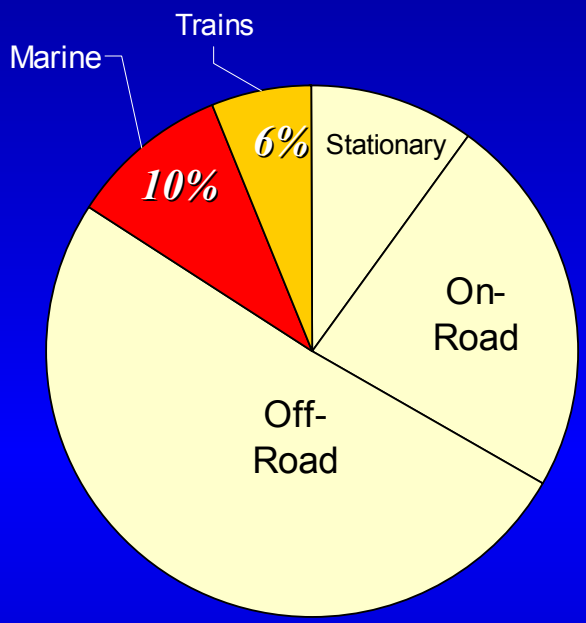


2010



2020

Marine & Locomotive Contribution to Statewide Diesel PM Emissions



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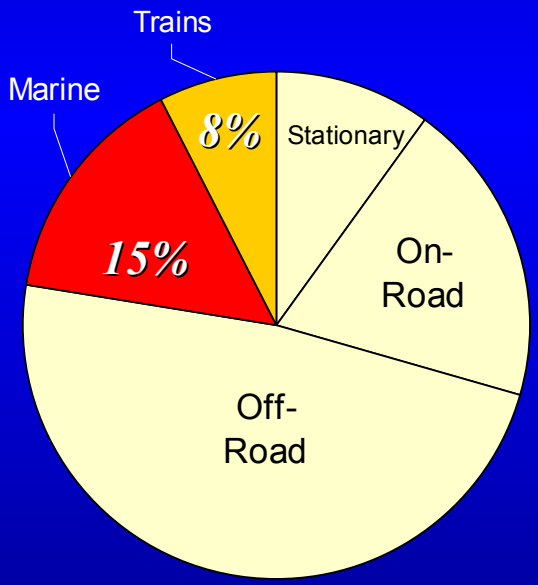

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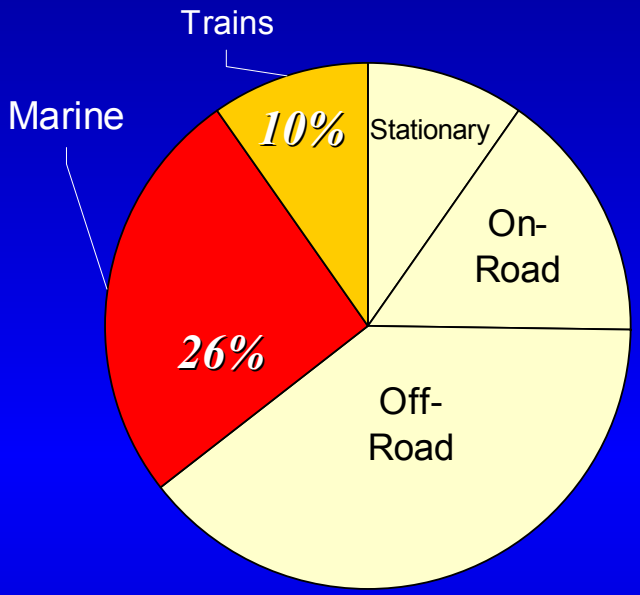

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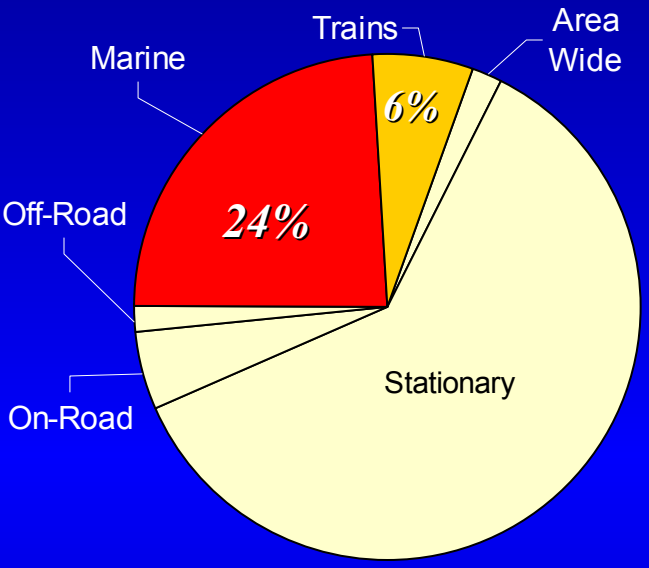
Marine & Locomotive Contribution to Statewide SOx Emissions



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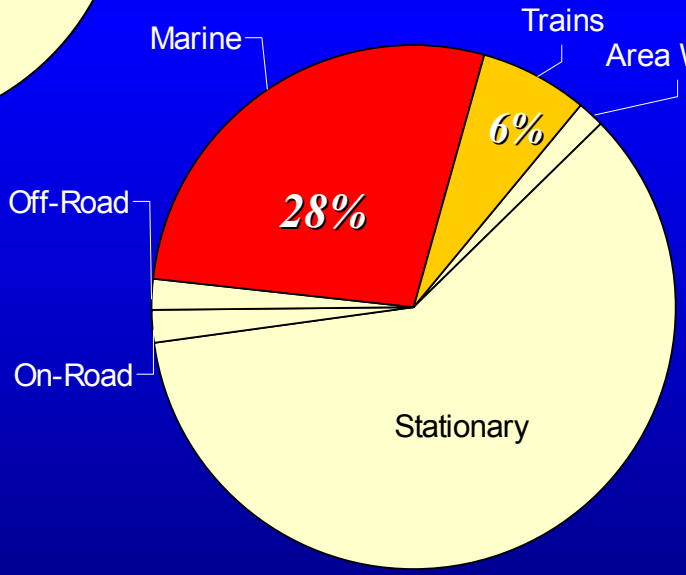

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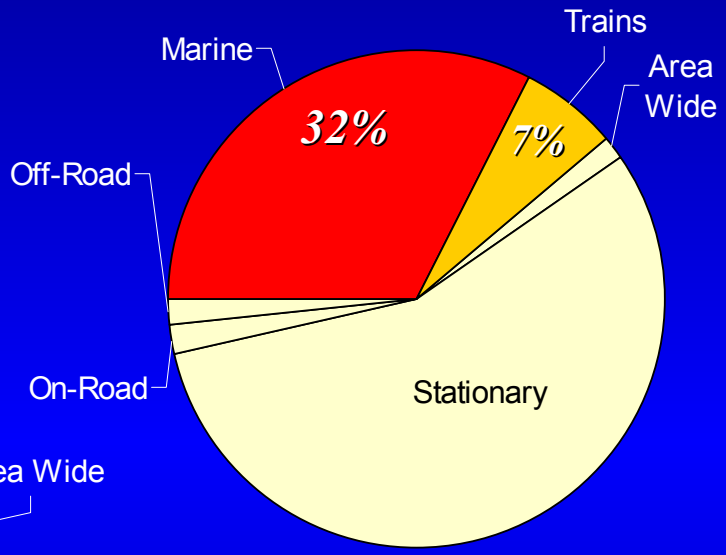

2020

Impacts on South Coast and San Joaquin Valley

- Marine and locomotive sources become increasingly significant over time
- Further reductions are crucial to meeting SIP commitments
- Further reductions will reduce risk associated with diesel PM

Marine Characteristics

- Oceangoing Ship Engines
  - **2.5 to 80 MW (3,000-107,000 h.p.) output**
  - **Single ship visit can generate 2- 5 tons NOx in CA**
  - **Majority are 2-stroke/long life**
- Harbor Craft
  - **Up to 8 MW (10,700 h.p.)**
  - **Many similar to locomotive engines**
  - **2- or 4-stroke**
- Auxiliary Engines and Boilers
  - **Auxiliary engines 4-stroke up to about 3 MW (4,000 h.p.)**
  - **Ships generally have multiple auxiliary engines**


OOCL
SEKIGAHARA

Locomotive Characteristics

- National fleet = 24,000 locomotives
- Line-haul (Freight)
  - 3000 - 6000 hp
  - Majority of in-use fleet are 1973 and newer
- Switchers
  - 1500 - 2000 hp
  - Half of in-use fleet are 1973 and newer


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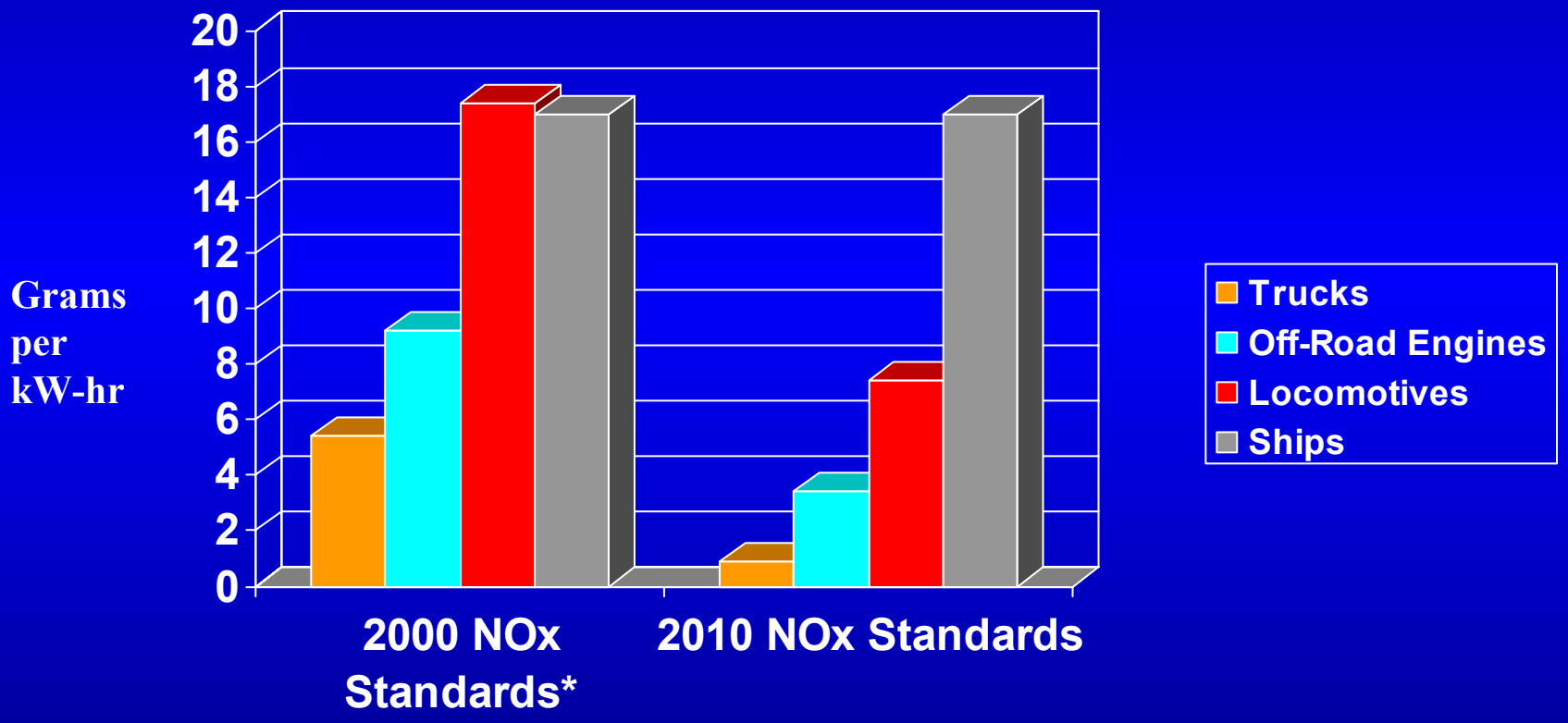
Current Commercial Marine Emission Reduction Measures

- Regulations
  - USEPA and IMO new engine standards provide modest reductions
  - Ferries must use CARB on-road diesel
- Voluntary Programs
  - Carl Moyer Program
  - Vessel Speed Reduction Program at Port of Los Angeles and Long Beach

Current Locomotive Emission Reduction Measures

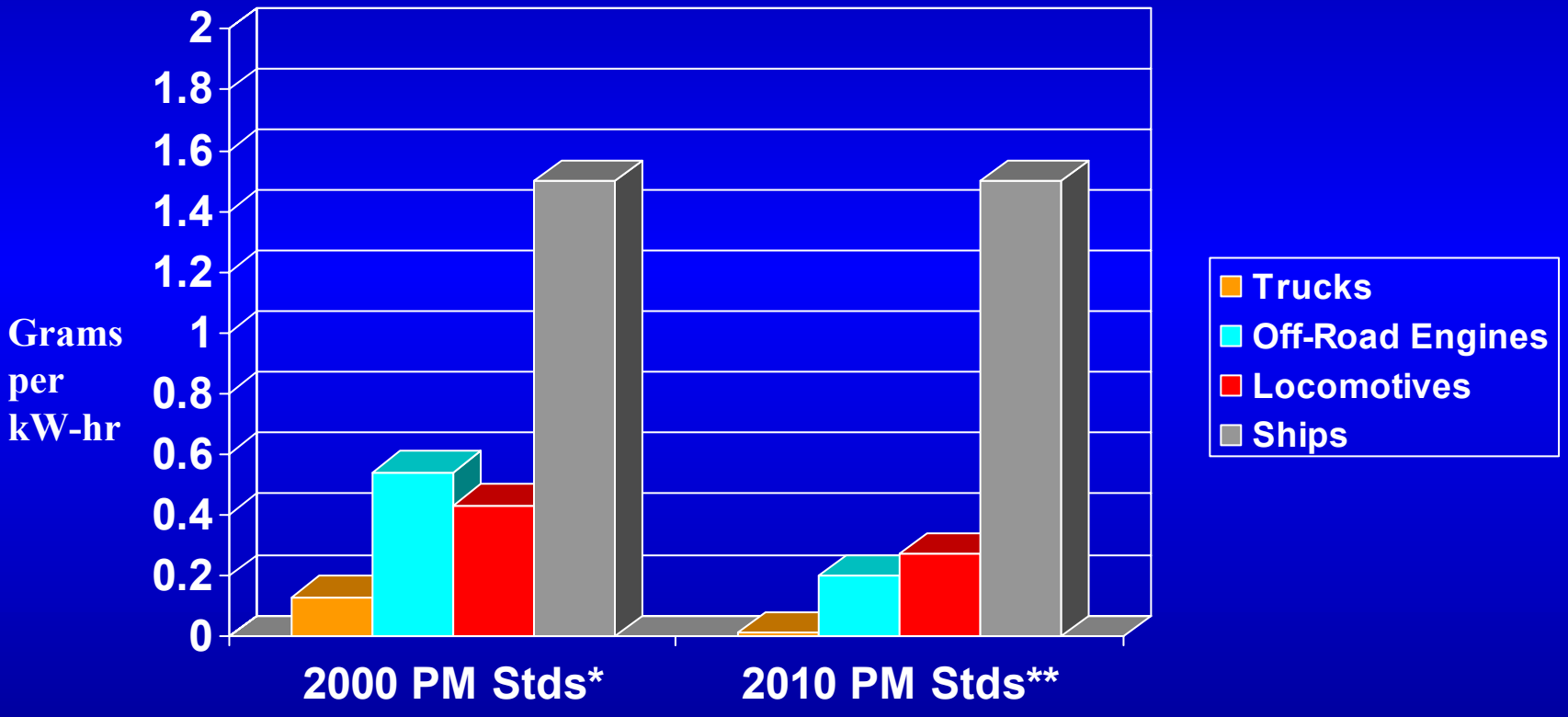
- Federal locomotive rule
  - HC, NOx, PM standards
  - New and rebuild stds (Tier 0, Tier 1, Tier 2)
- South Coast MOU
  - By 2010, the South Coast Air Basin locomotive fleet will essentially consist of only the cleanest locomotives available

Comparison of NOx Emission Standards



* 2000 line haul locomotive emissions level is uncontrolled average.

Comparison of PM Emission Standards



* 2000 ship and line-haul locomotive emissions levels are uncontrolled averages.
** 2010 ship emissions level is uncontrolled average.

California's Strategy for Marine Measures

- New Engine Standards
  - Encourage USEPA and the IMO to adopt lower standards for NOx & PM
- Clean up the In-Use Fleet
  - Retrofit Controls, Cleaner fuels, Operational Controls, Cold Ironing
- Port-Specific Programs
  - Additional controls for land-based sources

Current Activities Supporting Marine Vessel Program

- In-Use Emission Testing
- Oceangoing Ship Retrofit Project
- Harbor Craft Air Toxic Control Measure
- Developing Port-Specific Inventories
- Working cooperatively with West Coast States & Canada
- Evaluate options to reduce ship hotelling emissions

California's Strategy for Locomotives

- New programs to reduce locomotive emissions in SJV and statewide
  - Reduce idle time
  - Early introduction of clean locomotives
- Encourage U.S. EPA to pursue:
  - Aftertreatment based NOx and PM standards
  - Low sulfur fuel requirements
- Railyard emission reduction projects

Current Activities Supporting Locomotive Program

- Switcher retrofit program evaluating control technologies
  - UP/BNSF funded project
  - Goal: PM reduction through aftertreatment and oil consumption reduction
- Evaluating near source impacts of locomotives
- Working to update inventory

FUELS

MARINE

LOCOMOTIVE

Quality of Transportation Fuels Consumed in California

(in-use sulfur levels - ppmw)

Fuel Type	2003	2006/2007
CARB Diesel	140	10
EPA Diesel		
On-Road	340	10
Non-Road	3,200	340*
Marine Distillate	340-20,000	No Change
Marine Bunker Fuel	28,000	No Change

* Currently unregulated. US EPA has proposed regulations.

Quantity of Transportation Fuels Sold in California
(2000)

TYPE	GALLONS
• Gasoline	15,000 million
• Diesel	4,000 million
• Marine Bunker	2,000 million
• Locomotive Diesel	300 million
• Marine Distillate	100 million

Line Haul Locomotive and Oceangoing Ship Fueling Patterns

- Operate nationally and internationally.
- Low quality fuels with high sulfur content.
- Can fuel prior to arriving in California.
- Fuel storage capacity sufficient to avoid fueling in California.
- Most fuel dispensed in California consumed out-of-state.

Intrastate Locomotive and Harbor Craft Fueling Patterns

- Operate locally and regionally.
- Fueled primarily at California locations.
- Typically use higher quality fuels.

CLEANER FUEL OPPORTUNITIES

California Needs Cleaner Fuels

- Enables advanced control technologies.
- Provides criteria and toxic emission benefits.
  - NOx, SOx, and Diesel PM
- Challenges for line haul locomotives and oceangoing ships.
  - Need national and international fuel regulations.

Marine Cleaner Fuel Opportunities Under Evaluation

CARB Diesel:
Harbor craft
- *~25% PM Reduction*
- *~10% NOx Reduction*
- *Greater use of add-on controls*

Marine Distillate:
Ships at Dockside (auxiliary engines)
- *~60% PM Reduction*
- *~10% NOx Reduction*
- *~90% SOx Reduction*

Lower Sulfur Marine Bunker Fuel:
Oceangoing ships at sea (main engines)
- *~20% PM Reduction*
- *~40% SOx Reduction*

Locomotive Cleaner Fuel Opportunities Under Evaluation

Use of CARB Diesel:

Short Haul and Switchers

- *~5% NOx Reductions*
- *~20% PM Reductions*
- *Greater use of add-on controls*

USEPA's Proposed Non-Road Diesel:

Line Haul Locomotives

- *~90% SOx reductions*
- *~5% NOx reductions*
- *~20% PM reductions*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